

Providing female role models in **mathematics and computer science**



LYNDA WIEST



and **SHANNA JOHNSON**

explore resources and
strategies for
providing positive
female role models
in mathematics and
computer science.

Girls take as many mathematics courses as boys do in high school (National Center for Education Statistics [NCES], 2003). However, they show lower achievement in mathematics and are less likely to pursue mathematics-related fields. Take, for example, the 2000 National Assessment of Educational Progress (NAEP). Males outscored females at all three grade levels tested (fourth, eighth, and twelfth) (NCES, 2001). On the Scholastic Assessment Test – Mathematics (SAT-M), males scored 34 points higher than females for the 2001–2002 school year (NCES, 2003).

Women's interest and participation in computer science fields is also a concern. Moreover, women in these occupations are more likely than men to use computers for clerical and data-entry work (American Association of University Women [AAUW], 1998). The AAUW (1998) states: 'A discouraging new gap is emerging, as computer science becomes the new "boys' club". The failure to include girls in advanced-level computer science courses threatens to make women bystanders in the technological 21st century' (p. 4).

Fox and Soller (2001) say performance differences on the SAT-M can be costly for women in terms of college admissions and scholarship decisions. Further, mathematical and computer science fields — where women are much less likely to appear than men — are among the fastest-growing and highest-paying occupations (US Department of Labor, 2001).

Researchers and educators mainly attribute females' lower performance and participation in mathematics and computer science to females' attitudes and beliefs about these fields, including their perceptions of how gender-appropriate mathematics and computer science are for them as females (for example: Bae, Choy, Geddes, Sable & Snyder, 2000). Females may believe, for example, that males are naturally more mathematically and technologically inclined (Hanson, 1997).

One way teachers can help dispel such myths is by introducing students to historic and contemporary role models in mathematics and computer science. Male and female guest speakers might talk about their careers in these fields and how they use mathematics and technology on the job. Many print, audio-visual, and Web resources are now available for teachers and others to draw upon for providing students with role models in mathematics and computer science.

It is important for boys to be exposed to females in these fields, too, so that they perceive these disciplines as appropriate for females. This impacts the nature of the classroom climate in terms of how boys interact with girls, as well as ideas boys project beyond the classroom. Further, it is important that both girls and boys believe that all occupations are available to and appropriate for all people.

In this article, we share selected annotated resources that teachers may consult to infuse information about women in mathematics (and to a lesser degree, technology) into their classroom instruction. Posters and photos may be displayed in the classroom, and age-level-appropriate books may be made available for spare-time reading. Students might be asked to write a biography of an assigned mathematician or computer scientist from available books or pertinent websites. Teachers may consult the resources listed here, some of which are above elementary students' reading level, to further their own biographical knowledge. This way, they may incorporate relevant comments about female (and male) mathematicians and computer scientists into their instruction.

Drawing on what we believe to be the best of the Web resources listed below (found at www.agnesscott.edu/lriddle/women/alpha.htm), we used Puzzle Power software (Centron Technologies,

Inc., 2002) to create a word search puzzle (Figure 1) and a crossword puzzle (Figure 2) on famous women in mathematics and technology. We had upper-elementary-aged girls at a summer mathematics and technology camp work the puzzles. The word search helped the girls become familiar with the women's names. (Names in the puzzle appear forward, backward, and diagonally.)

The girls completed the crossword puzzle using printed biographies — from the website noted — of the twelve women who appear on the puzzle. (The puzzle uses the women mathematicians' last names only.) The biographies were prepared in packets that could be reused annually. The girls did the puzzle in pairs, although groups of three or four would work well, too. This type of task would also lend itself nicely to Internet research as homework, if all students have Internet access, or as a class activity in a computer lab.

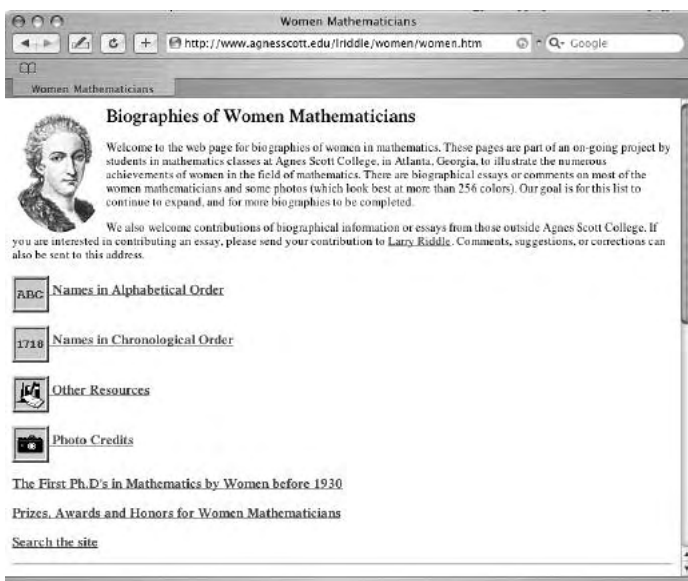
It was nice to hear the girls discuss details of these accomplished women in history as they worked on the puzzles. They continued to remember and occasionally mention the women mathematicians and computer scientists from time to time thereafter. We hope the print, audio-visual, and Web resources provided in this article, as well as the puzzles, will help your students gain better knowledge of and interest in the often-neglected legacy of women in mathematics and computer science. As noted, both girls and boys can benefit

from a broader view of who can succeed in and contribute to these fields.

Biographical resources in print and audio-visual materials

- Cooney, Miriam P. (Ed.) (1966). *Celebrating Women in Mathematics and Science*. Reston, Va.: National Council of Teachers of Mathematics. Book containing biographies of 22 women in mathematics and science across history, each about 10 pages long and containing a black-and-white sketch. Written for middle/junior high school but also appropriate for higher levels.
- Farquhar, Diane and Lynn Mary-Rosa (1989). *Women Sum It Up: Biographical Sketches of Women Mathematicians*. Christchurch, New Zealand: Hazard Press. Short biographies of women mathematicians appearing in two categories: European and American Women Mathematicians; New Zealand and Australian Women Mathematicians.
- Grinstein, Louise S. and Paul J. Campbell (Eds) (1987). *Women of Mathematics: A Biobibliographic Sourcebook*. New York: Greenwood Press. Biographies about and bibliographies of the work of 43 women mathematicians across history. Serves as a reference book, as well as inspirational reading for high school students and up.
- Hamrick, Chuck (artist) (1992). *Women in Science and Mathematics Poster*. Windsor, Calif.: National Women's History Project. Poster (22 x 27") of 20 women from a variety of science and mathematics fields.
- Morrow, Charlene and Teri Perl (Eds) (1998). *Notable Women in Mathematics: A Biographical Dictionary*. Westport, Conn.: Greenwood Press. Biographical essays, with pictures, of 59 women in or devoted to mathematics. The women, from diverse nations and cultures, lived from the 4th to 20th centuries (with a particular emphasis on the 20th century).
- National Science Foundation (1993). *Connecting the Past with the Future: Women in Mathematics and Science*. Macomb, Ill.: Curriculum Publications Clearinghouse, Western Illinois University. Videotapes include two that feature female mathematicians (Ada Lovelace, Mary Somerville). Accompanying classroom materials also available.
- National Women's History Project (1991, reprinted 1997). *Outstanding Women in Math and Science Photo Display*. Windsor, Calif.: Author. Photographs (8 1/2 x 11") and short biographies of 23 American women scientists and mathematicians from a wide variety of fields (includes 3 mathematicians as well as other scientists who use mathematics).
- Osen, Lynn M. (1974, reprinted 1995). *Women in Mathematics*. Cambridge, Mass.: MIT Press. Book that profiles 8 women in mathematics from the 4th to 20th centuries.
- Perl, Teri (1993). *Women and Numbers: Lives of Women Mathematicians plus Discovery Activities*. San Carlos, Calif.: Wide World Publishing/Tetra. Biographies of 13 women mathematicians from the 19th and 20th centuries and activities based on their work. Multicultural with many pictures. Most appropriate for upper elementary and middle grades.

- Reimer, Luetta and Wilbert Reimer (1990, 1995). *Mathematicians Are People, Too: Stories from the Lives of Great Mathematicians, Vols I and II*. Palo Alto, Calif.: Dale Seymour Publications. Two volumes that each profile 15 mathematicians, including three women in the first and four in the second. Multiple cultures represented. Grades 3–7.
- Riley, Jocelyn (Producer) (1998). *Math at Work*. Madison, Wisc.: Her Own Words (608-271-7083; herownword@aol.com). 15-minute videotape featuring 13 women in mathematics-related careers; resource guide available.
- Verheyden-Hilliard, Mary Ellen. (1985). *Mathematician and Administrator, Shirley Mathis McBay*. Bethesda, Md.: The Equity Institute. Brief biography of the woman mathematician who was the first African American to earn a PhD from the University of Georgia. Grades 2–4.
- Verheyden-Hilliard, Mary Ellen. (1988). *Mathematician and Computer Scientist, Caryn Navy*. Bethesda, Md.: The Equity Institute. Brief, illustrated biography of Caryn Navy, who became blind at age ten and went on to earn her doctorate in mathematics and head her own computer company. Grades 2–4.



Biographical resources on websites

- Biographies of Women Mathematicians* (Agnes Scott College): <http://www.agnesscott.edu/lriddle/women/women.htm>. Biographies of women mathematicians, some of which include pictures, and links to other resources on women mathematicians and scientists.
- Biographies of Women Mathematicians* (Canadian Mathematical Society): <http://camel.math.ca/Women/BIOG/Biographies>. Information and links of interest to women in mathematics and to women considering careers in mathematics. Topics include: Educational Issues; Biographies of Women Mathematicians; Organisations; Books, Articles, Speeches, and Bibliographies; Miscellaneous.
- Black Women in Mathematics* (The State University of New York at Buffalo): <http://www.math.buffalo.edu/mad/wmad0.html>. Historical details, biographies, and related information on black women in the mathematical sciences.
- MacTutor History of Mathematics Archive: Indexes of Biographies* (University of St. Andrews, Scotland): <http://www-groups.dcs.st-and.ac.uk/~history/BiogIndex.html>. Extensive number of biographies of male and female mathematicians arranged alphabetically and chronologically.
- Women in Math: People Info* (University of Oregon): <http://darkwing.uoregon.edu/~wmnmath/People>. Biographies of women mathematicians; links to history-of-mathematics sites with short descriptions of their contents.

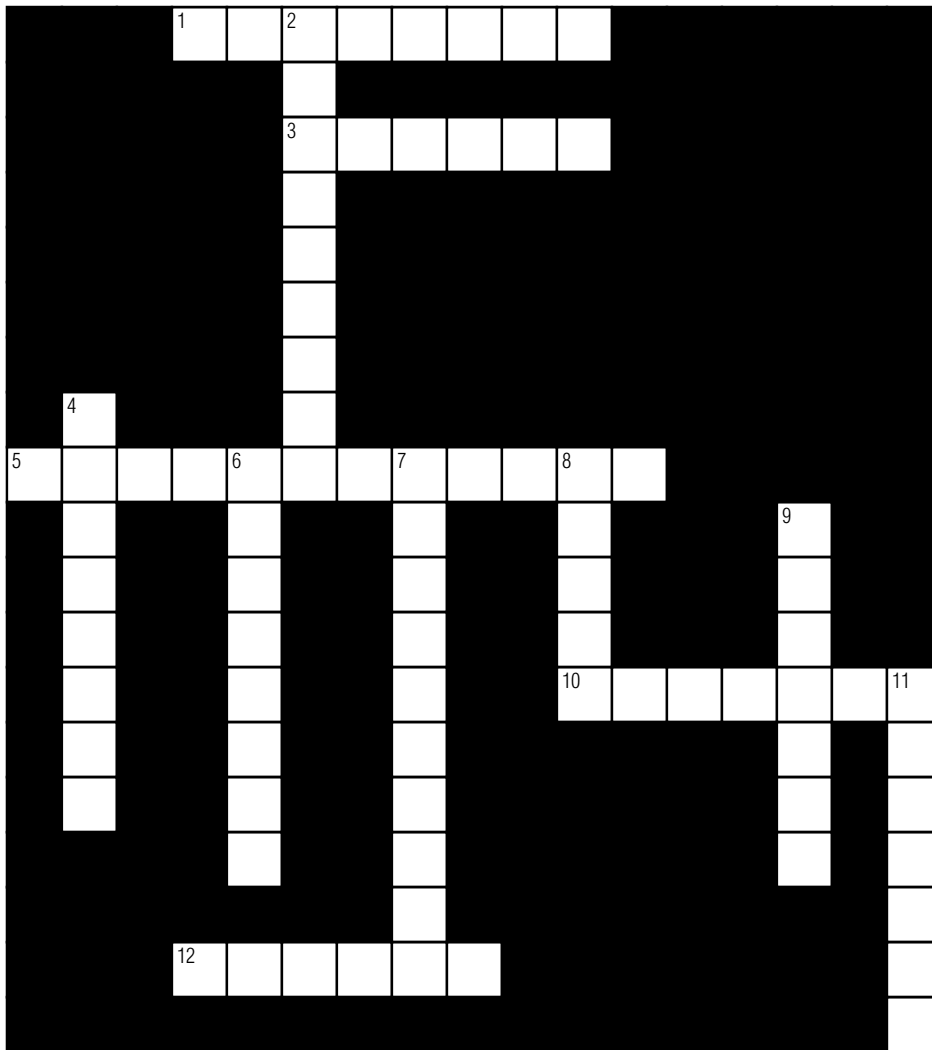
Famous women in mathematics and technology

T E C R E P P O H Y A R R U M E C A R G
W G S O P H I E G E R M A I N J P O E M
O M R D R D A U J Q W C Y N X D A V W A
E A I A P T V F C O B P N M U I E P S R
C R I N C F W P J C K V P J T L X N A Y
A I H Z D E D E C X C J A A Y G X H F S
L A Y P Y I C N V E A P P N Q H Q H S O
E A H U V N R H W U L Y B K A O Q H G M
V G N G Q D T B I Q H O F L K U N V O E
O N G U K R J J L S Y U D P S W N A D R
L E Z Y V M F V Y D H K X R F R U T R V
N S K S B I E V G H Z O G G M F W M A I
O I T F V T D R W H Q Z L Y C W G L X L
R X O C D C A Y N L X J P M M L A H V L
Y A D R P N Q F E H I J O V Y I X U J E
B N S I V W S F M P D Y Z H O O B A N D
A H Q I D X L B L B X Z Z J Q F U B P M
D K L W P L E M P U H N S L J Z S N V C
A L E M M Y N O E T H E R K B R T V G C
E S O F I A K O V A L E V S K A Y A I C

ADA BYRON LOVELACE
EMMY NOETHER
EVELYN BOYD GRANVILLE
GRACE CHISHOLM YOUNG
GRACE MURRAY HOPPER

HYPATIA
MARIA AGNESI
MARY SOMERVILLE
SOFIA KOVALEVSKAYA
SOPHIE GERMAIN

Solutions to
these two puzzles
can be found on
page 25.



ACROSS

1. First American woman to earn a PhD in mathematics; photo hangs at Columbia University with the saying, 'She opened the door'.
3. Mathematician who wrote, read and spoke seven languages.
5. Self-taught mathematician.
10. Developed modern theory of elasticity.
12. US naval officer who coined the term 'computer bug'.

DOWN

2. Mathematics analyst for US space program; second Black woman to PhD in mathematics.
4. First woman president of the American Mathematical Society (1982).
6. Did pioneering groundwork in computer programming during her short life.
7. Accomplished mathematician who persuaded her younger brother's tutor to introduce algebra to her.
8. First European woman to receive a formal doctorate in mathematics.
9. First well-known female mathematician.
11. 'Mother' of algebra.

References

- American Association of University Women (1998). *Gender Gaps: Where Schools Still Fail Our Children* [executive summary]. Washington, D. C.: American Association of University Women Educational Foundation. Retrieved 2 May 2002 from <http://www.aauw.org/research/GGES.pdf>.
- Bae, Y., Choy, S., Geddes, C., Sable, J. & Snyder, T. (2000). Trends in educational equity of girls and women. *Education Statistics Quarterly* 2, 115–120.
- Centron Technologies Inc. (1993–2002). *Puzzle Power [version 3.2]*. Pinehurst, N.C.: Centron Technologies Inc.
- Fox, L. H. & Soller, J. F. (2001). Psychosocial dimensions of gender differences in mathematics. In J. E. Jacobs, J. R. Becker & G. F. Gilmer (Eds), *Changing the Faces of Mathematics: Perspectives on Gender* (pp. 9–24). Reston, Va.: National Council of Teachers of Mathematics.
- Hanson, K. (1997). *Gender, Discourse, and Technology*. Newton, Mass.: Education Development Center.
- National Center for Education Statistics (2001). *The Nation's Report Card*. Washington, D.C.: Author. Retrieved 2 May 2002 from: <http://nces.ed.gov/nationsreportcard/mathematics/results/>.
- National Center for Education Statistics (2003). *Digest of Education Statistics, 2002*. Retrieved 11 January 2004 from <http://nces.ed.gov/programs/digest/d02>.
- US Department of Labor (2001). *Highlights of Women's Earnings in 2000*. Washington, DC: US Department of Labor, Bureau of Labor Statistics.

Lynda R. Wiest
University of Nevada, Reno, USA
<wiest@unr.edu>
Shanna L. Johnson
Cottonwood Elementary School
Fernley, Nevada, USA.
<sjohnson@lyon.k12.nv.us>